Chapter 2

General Recommendations on Immunization

Timing and Spacing of Vaccines

The timing and spacing of vaccine doses are two of the most important issues in the appropriate use of vaccines. Specific circumstances that are commonly encountered in immunization practice are the timing of antibody-containing blood products and live vaccines (particularly measles vaccine), simultaneous and nonsimultaneous administration of different vaccines, and the intervals between subsequent doses of the same vaccine.

Issues Regarding Spacing and Timing of Vaccines

- **Interval between receipt of antibody-containing blood products and measles vaccine**
- **Interval between doses of different vaccines not administered simultaneously**
- **Interval between subsequent doses of the same vaccine**

Antibody-vaccine interactions

General Rule

Inactivated vaccines generally are not affected by circulating antibody to the antigen.

Live attenuated vaccines may be affected by circulating antibody to the antigen.

The presence of circulating antibody against a vaccine antigen may reduce or completely eliminate an immune response to the vaccine. The amount of interference produced by circulating antibody generally depends on the type of vaccine administered and the amount of antibody.

Inactivated antigens are not substantially affected by circulating antibody, so they can be administered before, after, or at the same time as the antibody. Simultaneous administration of antibody (in the form of immune globulin) and vaccine is recommended for postexposure prophylaxis of certain diseases, such as hepatitis B, rabies, and tetanus.

Antibody and Live Vaccines

Product Given First	Action
Live Vaccine	Wait 2 weeks before giving antibody
Antibody	Wait >3 months before giving vaccine (see Table, Appendix A)

All live vaccines must replicate in order to cause an immune response. Antibody against live injected vaccine antigen may interfere with replication. If a live injected vaccine (MMR or varicella) must be given around the time that antibody is given, the two must be separated by enough time so that the antibody does not interfere with viral replication. If the live vaccine is given first, it is necessary to wait **at least 2 weeks** *(i.e.*, an incubation period) before giving the antibody. If the interval between the vaccine and antibody is less than 2 weeks, the recipient should be tested for immunity or the vaccine dose should be repeated.

If the antibody is given before a dose of MMR or varicella vaccine, it is necessary to wait until the antibody has waned (degraded) before giving the vaccine. In past recommendations, the interval between receipt of antibody (immune globulin or other blood products) and live injected vaccines has been a minimum of 6 weeks and preferably 3 months. However, a recent study suggests that this interval is not always long enough to eliminate interference between the antibody and the vaccine.

The current recommendation is that the necessary interval between an antibody-containing product and MMR or varicella vaccine varies depending on the concentration of antibody in the product. A table listing the recommended intervals between antibody products and live vaccines (MMR and varicella) is included in Appendix A, and in the *General Recommendations on Immunization*.

Oral polio, and yellow fever vaccines are not affected by the administration of immune globulin or blood products. They may be given simultaneously with blood products, or separated by any interval. Polio virus replicates in the GI tract, and seem to be "protected" from the effects of circulating antibody. Yellow fever vaccine is not affected because few North Americans are immune to yellow fever. Consequently, donated blood products in the United States do not contain a significant amount of yellow fever antibody.

Simultaneous and non-simultaneous administration

General Rule

There are no contraindications to simultaneous administration of any vaccines.*

***except cholera and yellow fever**

The simultaneous administration of the most widely used live and inactivated vaccines does not result in decreased antibody responses or increased rates of adverse reaction.

Yellow fever and cholera vaccines should not be administered simultaneously. It has been observed that simultaneous administration of these vaccines decreases the antibody response to both vaccines. These vaccines should be separated by at least 3 weeks, if possible.

When vaccines commonly associated with local or systemic side effects (*e.g.*, cholera, whole cell killed typhoid, or plague) are given simultaneously, the side effects might be accentuated. When feasible, it is preferable to give these vaccines on separate occasions. This does not apply to influenza and pertussis vaccines, which are recommended to be given simultaneously when indicated.

Simultaneous administration of all vaccines for which a child is eligible can be very important in childhood vaccination programs because it increases the probability that a child will be fully immunized at the appropriate age. A study during a recent measles outbreak showed that about one-third of measles cases in unvaccinated but vaccine-eligible preschool children could have been prevented if MMR had been administered at the same visit when another vaccine was given.

Individual vaccines should not be mixed in the same syringe unless they are licensed for mixing by the FDA. Only the Aventis-Pasteur Hib/ whole cell DTP (ActHIB/DTP) and Hib/DTaP (TriHIBit™) vaccines have been licensed for mixing in the same syringe.

Non-simultaneous administration of different vaccines

In some situations, vaccines that could be given simultaneously are not (*e.g.*, if the child is receiving vaccines from two different providers).

The table below gives the suggested intervals if vaccines are not administered simultaneously.

Spacing of Live and Inactivated Vaccines Not Administered Simultaneously

Combination	Minimum Interval
Two live injected	4 weeks
Cholera & yellow fever	3 weeks
All other	None

Live injected vaccines (MMR, varicella, and yellow fever) that are not administered simultaneously should be separated by at least 4 weeks. This precaution is intended to reduce or eliminate interference from the vaccine given first on the vaccine given later. If two live injected vaccines are not administered simultaneously but are separated by less than 4 weeks, it may be prudent to repeat the vaccine given second, or confirm that the dose was effective by serologic testing of the recipient.

Live oral vaccines (OPV and oral typhoid) are not believed to interfere with each other if not given simultaneously. These vaccines may be given at any time before or after each other. Oral typhoid is not licensed for children less than 6 years of age, and OPV is no longer recommended, so these vaccines are not likely to be given to the same child.

Injected live vaccines (MMR, varicella, and yellow fever) are not believed to have an effect on live vaccines given orally (OPV and oral typhoid). Live oral vaccines may be given at any time before or after live injected vaccines.

For reasons that are not clear, cholera and yellow fever vaccines interfere with each other. These vaccines should not be given simultaneously, and should be separated by at least 3 weeks. Priority should always be given to yellow fever vaccination of a person traveling to a yellow fever endemic area. Cholera vaccine has very limited protective efficacy, and is generally not recommended for travelers to any part of the world.

All other combinations of two inactivated vaccines, or live (injected or oral) and inactivated vaccines may be given at any time before or after each other.

Interval between doses of the same vaccine

General Rule

Increasing the interval between doses of a multi-dose vaccine does not diminish the effectiveness of the vaccine.

Decreasing the interval between doses of a multi-dose vaccine may interfere with antibody response and protection.

All vaccines should be administered as close to the recommended schedule as possible to maximize the protection from the vaccine. Recommended spacing between doses should be maintained. If a child is not up-to-date on his or her vaccinations, it may be necessary to "accelerate" the normal schedule in order to catch up. In this situation it is important to know how closely the doses can be spaced and still be effective.

Another situation in which minimum spacing is important is when vaccine is given in other countries. The spacing of vaccines in other countries is frequently different from what is acceptable in the United States. Additional details on determining the acceptability of vaccines given in other countries are given in the *General Recommendations on Immunization*.

Doses of a vaccine given too close together could reduce the effectiveness of the vaccine and effort should be made to maintain at least the minimum interval between doses. A table listing the **minimum interval between doses** of vaccine is included in Appendix A.

In some cases, a scheduled dose of vaccine may not be given on time. If this occurs, the dose should be given at the next visit. **It is not necessary to restart the series of any vaccine due to extended intervals between doses.** The only exception to this rule is oral typhoid vaccine in some circumstances. In the case of oral typhoid, the manufacturer recommends repeating the series if the 4 dose series is extended to more than 10 days.

It is not necessary to restart the series of any vaccine* due to extended intervals between doses.

***except oral typhoid in some circumstances.**

Number of doses

General Rule

Live attenuated vaccines generally produce longlasting immunity with a single dose.

Inactivated vaccines require multiple doses and may require periodic boosting to maintain immunity.

For live injected vaccines, the first dose usually provides protection. An additional does is given to ensure seroconversion. For instance, 95% to 98% of recipients will respond to a single dose of measles vaccine. The second dose is given to assure that nearly 100% of persons

are immune (*i.e.*, the second dose is "insurance"). Immunity following live vaccines is long-lasting, and booster doses are not necessary.

For inactivated vaccines, the first dose usually does not provide protection. A protective immune response may not develop until the second or third dose.

For inactivated vaccines, antibody titers may decrease ("wane") below protective levels after a few years. This phenomenon is most notable for tetanus and diphtheria. For these vaccines, periodic "boosting" is required. An additional dose is given to raise antibody back to protective levels.

Not all inactivated vaccines require boosting throughout life. For example, Hib vaccine does not require boosting because Hib disease is very rare in children older than 5 years of age. Hepatitis B vaccine does not require boosting because of immunologic memory to the vaccine and the long incubation period of hepatitis B (which can produce an "autoboost").

Adverse Reactions Following Vaccination

Vaccines are intended to produce active immunity to specific antigens. An **adverse reaction** is an untoward effect caused by a vaccine that is extraneous to the vaccine's primary purpose of production of immunity. Adverse reactions are also called vaccine side effects. A vaccine **adverse event** refers to *any* adverse event that occurs following vaccination. An adverse event could be a true vaccine reaction, or just a coincidental event, with further reseach needed to distinguish between them.

Vaccine Adverse Reactions

- **Adverse reaction**
  - **extraneous effect *caused by the vaccine***
  - **"side effect"**
- **Adverse event**
  - ***any* event following a vaccine**
  - **may be true adverse reaction**
  - **may be only coincidental**

Vaccine adverse reactions fall into three general categories - local, systemic, and allergic. Local reactions generally the least severe and most frequent. Allergic reactions are the most severe and least frequent.

Vaccine Adverse Reactions

- **Local**
  - **pain, swelling, redness at site of injection**
  - **common with inactivated vaccines**
  - **usually mild and self-limited**

The most common type of adverse reactions are **local reactions**, such as pain, swelling, and redness at the site of injection. Local reactions may occur in up to 50 percent of vaccine doses, depending on the type of vaccine. Local reactions are most common with inactivated vaccines, particularly those, such as DTaP, that contain adjuvants. Local adverse reactions generally occur within a few hours of the injection and are usually mild and self limited. On rare occasions, local reactions may be very exagerated or severe. These are often referred to as hypersensitivity reactions, although they are not allergic, as the term implies. These reactions are also known as Arthus reactions, and are most commonly seen with tetanus and diphtheria toxoids. Arthus reactions are believed to be due to very high titers of antibody, usually because of too many doses of toxoid.

Systemic adverse reactions are more generalized events, and include fever, malaise, myalgias (muscle pain), headache, loss of appetite, and others. These symptoms are common and nonspecific, and may occur in a vaccinated persons because of the vaccine, or may be caused by something unrelated to the vaccine, like a concomitant viral infection.

Systemic adverse reactions were relatively frequent with whole cell DTP vaccine. However, comparison of the frequency of systemic adverse events among vaccine and placebo recipients show they are uncommon with inactivated vaccines currently in use, including acellular pertussis vaccine.

Systemic adverse reactions are more common following live attenuated vaccines than inactivated vaccines. Live attenuated vaccines must replicate in order to produce immunity. The adverse reactions that follow live attenuated vaccines, such as fever or rash represent symptoms produced from that replication, and are similar to a mild form of the natural disease. Systemic adverse reactions following live vaccines are usually mild, and occur a week or two after the vaccine was given (*i.e.*, after an incubation period of the vaccine virus).

A third type of vaccine adverse reaction is a severe **allergic reaction**. The allergic reaction may be caused by the vaccine antigen itself, or some other component of the vaccine, such as cell culture material, stabilizer, preservatives, or antibiotic used to inhibit bacterial growth. Severe allergic reactions to vaccines may be life-threatening. Fortunately, they are very rare, occurring at a rate of less than one in half a million doses. The risk of an allergic reaction may be minimized by good screening prior to vaccination.

Reporting vaccine adverse events

From 1978 to 1990, the CDC conducted the Monitoring System for Adverse Events Following Immunization (MSAEFI) in the public sector. In 1990, MSAEFI was replaced by the Vaccine Adverse Events Reporting System (VAERS), which includes reporting from both public and private sectors. Adverse events requiring medical attention occurring within 30 days after receipt of a vaccine should be reported to this system. The telephone number to call for answers to questions and to obtain VAERS forms is (800) 822-7967.

Vaccine Adverse Reactions

- **Local**
- **Systemic**
  - **fever, malaise, headache**
  - **nonspecific**
  - **may be unrelated to vaccine**
  - **may be specific to the vaccine**

Live Attenuated Vaccines

- **Must replicate to produce immunity**
- **Symptoms similar to a mild case of the disease (e.g., rash, fever)**
- **Occur after an incubation period (usually 7-21 days)**

Vaccine Adverse Reactions

- **Local**
- **Systemic**
- **Allergic**
  - **due to vaccine or vaccine component**
  - **rare**
  - **risk minimized by screening**

Contraindications and Precautions to Vaccination

Contraindications and precautions to vaccination generally dictate circumstances when vaccines will not be given. Most contraindications and precautions are temporary and the vaccine can be given at a later time.

Contraindication
- **A condition in a recipient that *greatly increases* the chance of a serious adverse event**

Precaution
- **A condition in a recipient that *may increase* the chance of an adverse event**
- **May compromise the ability of the vaccine to produce immunity**

A **contraindication** is a condition *in a recipient* that *greatly increases* the chance of a serious adverse reaction. It is a condition in the recipient of the vaccine, not with the vaccine itself. If the vaccine were given in the presence of that condition, the resulting adverse reaction could seriously harm the recipient. For instance, administering influenza vaccine to a person with a true anaphylactic allergy to egg could cause serious illnes or death in the recipient. In general, vaccines are never administered when a contraindication condition is present.

A **precaution** is similar to a contraindication. A precaution is a condition in a recipient that *may increase* the chance of a serious adverse reaction, or that may compromise the ability of the vaccine to produce immunity (such as administering measles vaccine to a person with passive immunity to measles from a blood transfusion). Injury could result, but the chance of this happening is less than with a contraindication. Under normal circumstances, vaccines are deferred when a precaution condition is present. However, situations may arise when the benefit of protection from the vaccine outweighs the risk of an adverse reaction, and a provider may decide to give the vaccine. For example, prolonged crying or a high fever after a dose of whole cell or acellular pertussis vaccine is considered a precaution to giving subsequent doses of pertussis vaccine to a child. But if the child were at high risk of pertussis infection (e.g., a pertussis outbreak in the community), a provider may choose to vaccinate the child and treat the adverse reaction if it occurs. In this example, the benefit of protection from the vaccine outweighs the harm potentially caused by the vaccine.

Contraindications and Precautions

Permanent contraindications to vaccination:
- **severe allergy to a prior dose of vaccine or to a vaccine component**
- **encephalopathy following pertussis vaccine**

There are very few true contraindication and precaution conditions. Only two of these conditions are generally considered to be permanent: **severe allergy to a vaccine component or following a prior dose of a vaccine**, and **encephalopathy within 7 days of pertussis vaccination**.

Four conditions are considered permanent precautions to further doses of pertussis-containing vaccine: temperature >105°F, collapse or shock-like state (hypotonic hyporesponsive episode), and persistent inconsolable crying lasting 3 or more hours occurring within 48 hours of a dose, or a seizure, with or without fever, occurring within 3 days of a dose.

Two conditions are temporary contraindications to vaccination with live vaccines: **pregnancy** and **immunosuppression**. Two conditions are temporary precautions to vaccination: **moderate or severe acute illness** (all vaccines), and **recent receipt of an antibody-containing blood product** (live injected vaccines only).

Contraindications and Precautions

Condition	Live	Inactivated
Allergy to Component	C	C
Encephalopathy	---	C
Pregnancy	C	V
Immunosuppression	C	V
Moderate-severe illness	P	P
Recent blood product	P	V

C=contraindication P=precaution V=vaccinate if indicated

Allergy

A severe allergic reaction following a dose of vaccine will virtually always contraindicate a subsequent dose of that vaccine. Severe allergies are those which are mediated by IgE, occur within minutes or hours of the vaccine, and require medical attention. Examples of severe allergic reactions are generalized urticaria (hives), swelling of the mouth and throat, difficulty breathing, wheezing, hypotension, or shock. With appropriate screening these reactions are very rare following vaccination. A table listing vaccine contents is included in Appendix A.

Persons may be allergic to the vaccine antigen, animal protein, antibiotics, preservatives, or stabilizers. The most common animal protein allergen is egg protein found in vaccines prepared using embryonated chicken eggs (*e.g.*, yellow fever and influenza vaccines). Ordinarily, persons who are able to eat eggs or egg products safely can receive these vaccines; persons with histories of anaphylactic or anaphylactic-like allergy to eggs or egg proteins should not. Asking persons whether they can eat eggs without adverse effects is a reasonable way to screen for those who might be at risk from receiving yellow fever, and influenza vaccines.

Several recent studies have shown that children who have a history of severe allergy to eggs rarely have reactions to MMR vaccine. This is probably because measles and mumps vaccine viruses are both grown in chick embryo fibroblasts, not actually in eggs. It appears now that it may be gelatin, not egg, that causes allergic reactions to MMR. As a result, in 1997, ACIP removed severe egg allergy as a contraindication to measles and mumps vaccines. Egg allergic children may be vaccinated with MMR without prior skin testing.

Pregnancy

The concern about vaccinating pregnant women is with infection of the fetus, and is theoretical. There is no evidence that any live vaccine (including rubella) causes birth defects. See the rubella chapter for more information. However, since the theoretical possibility exists, live vaccines should not be given to pregnant women.

Since inactivated vaccines cannot replicate, they cannot cause fetal infection. Inactivated vaccines should be administered to pregnant women for whom they are indicated.

Immunosuppression

Immunosuppression
Disease

- **Congenital immunodeficiency**
- **Leukemia or lymphoma**
- **Generalized malignancy**

Live vaccines can cause severe or fatal reactions in immunosuppressed persons due to uncontrolled replication of the vaccine virus, particularly oral polio vaccine virus (and rarely measles vaccine virus). Severely immunosuppressed persons should not be given live vaccines for this reason. Persons with isolated B-cell deficiency may receive varicella vaccine. Inactivated vaccines cannot replicate, so are safe to use in immunosuppressed persons. However, response to the vaccine may be decreased.

Both diseases and drugs can cause significant immunosuppression. Persons with congenital immunodeficiency, leukemia, lymphoma, or generalized malignancy should not receive live vaccines. OPV should not be given if an immunosuppressed person is in the household. However, MMR and varicella vaccines may be given when an immunosuppressed person lives in the same house.

Immunosuppression
Chemotherapy

- **Alkylating agents**
- **Antimetabolites**
- **Radiation**

Certain drugs may cause immunosuppression. For instance, persons receiving cancer treatment with alkylating agents or antimetabolites, or radiation therapy should not be given live vaccines. Live vaccines can be given after chemotherapy has been discontinued for at least 3 months. Persons receiving large doses of corticosteroids should not receive live vaccines. This would include persons receiving 20 milligrams of prednisone daily or more than 2 milligrams of prednisone per kilogram of body weight per day.

Aerosolized steroids, such as inhalers for asthma, alternate day, rapidly tapering, and short (<14 days) high dose schedules, topical formulations, and physiologic replacement schedules are not contraindications to vaccination.

Immunosuppression
Corticosteroids
- **≥20 mg per day**
- **≥2 mg/kg per day**
- **NOT aerosols, topical, alternate day, short courses**

Inactivated vaccines are not contraindicated for immunosuppressed persons. However, response to the vaccine may be poor. A relatively functional immune system is required in order to develop an immune response to a vaccine. So an immunosuppressed person may not be protected, even if the vaccine has been given. Additional recommendations for vaccination of immunosuppressed persons are detailed in the *General Recommendations on Immunization* and in a specific Altered Immunocompetence ACIP statement.

HIV infection

Recommendations for Routine Immunization of HIV-infected Children

Vaccine	Asymptomatic	Symptomatic
OPV	No	No
Varicella	Yes	No
MMR	Yes	No
All others	Yes	Yes

Persons infected with human immunodeficiency virus (HIV) may have no symptoms, or may be severely immunosuppressed. In general, the same vaccination recommendations apply as with other types of immunosuppression. Live virus vaccines are usually contraindicated, and inactivated vaccines are not contraindicated.

Oral polio vaccine should not be given to a person with HIV infection or AIDS, or to a child whose household contact has HIV infection or AIDS. Varicella vaccine should not be given to a person known to be infected with HIV, but is recommended for healthy persons whose household contact has HIV infection.

Measles and varicella can be very severe illnesses in persons with HIV infection and is often associated with complications. Therefore, measles vaccine (as combination MMR vaccine) and varicella vaccine are recommended for persons with HIV infection who are asymptomatic or mildly immunosuppressed. However, persons with severe immunosuppression due to HIV infection should not receive measles vaccine, MMR, or varicella vaccine.

Moderate or severe acute illness

There is no evidence that a concurrent acute illness reduces vaccine efficacy or increases vaccine adverse events. The concern is that an adverse event (particularly fever) following vaccination could complicate the management of a severely ill person. If a person has a

moderate or severe acute illness, vaccination with both live and inactivated vaccines should be delayed until the illness has improved.

Mild, common illnesses (such as otitis media, upper respiratory infections, colds, and diarrhea) are **NOT** contraindications to vaccination.

Recent blood products

Blood products may interfere with the replication of live injected vaccine viruses. Recent receipt of blood products is a precaution to MMR and varicella vaccines. OPV and oral typhoid are not affected by circulating antibody, and blood products in the United States do not contain enough yellow fever antibody to interfere with replication of that vaccine. Palivizumab (Synagis) is a monoclonal antibody product used to treat RSV. It contains only antibody to RSV, so will not interfere with live virus vaccination.

Varicella and MMR vaccines should be given 14 days prior to the blood product, or delayed until the antibody has degraded (see Table 8 in Appendix A). If MMR is given sooner than the minimum interval shown, the recipient should be tested for immunity or the dose repeated after the appropriate interval.

Inactivated vaccines are not substantially affected by circulating antibody from blood products and are not contraindicated.

Invalid Contraindications to Vaccination

Invalid Contraindications to Vaccination
- **Mild illness**
- **Antibiotic therapy**
- **Disease exposure or convalescence**
- **Pregnancy in the household**
- **Breastfeeding**
- **Premature birth**
- **Allergies to products not in vaccine**
- **Family history unrelated to immunosuppression**
- **Need for TB skin testing**
- **Need for multiple vaccines**

Some health care providers inappropriately consider certain conditions or circumstances to be true contraindications or precautions to vaccinations. Such conditions or circumstances are known as invalid contraindications, and result in missed opportunities to administer needed vaccines. Some of the most common invalid contraindications are minor illnesses, conditions related to pregnancy and breast-feeding, allergies that are not anaphylactic in nature, and certain aspects of the patient's family history.

Minor illness

Children with mild acute illnesses, such as low-grade fever, upper respiratory infection, colds, otitis media, and mild diarrhea, can and **should be vaccinated**.

Several large studies have shown that young children with URI, otitis media, diarrhea, and/or fever respond to measles vaccine as well as those without these conditions. These large studies refute the results of an earlier small study (Krober, *JAMA* 1991) which suggested that minor

infections such as URIs might impair the response to measles vaccine. Further, there is no evidence that mild diarrhea reduces the success of immunization of infants in this country.

Low-grade fever is not a contraindication to immunization. Temperature measurement is not necessary before immunization if the infant or child does not appear ill and the parent does not say the child is currently ill.

Invalid Contraindications
Minor Illness

Examples:
- **low grade fever**
- **upper respiratory infection**
- **otitis media**
- **mild diarrhea**

- **Only one study has suggested decreased efficacy of measles vaccine in children with URI**
- **Findings not replicated by multiple prior and subsequent studies**
- **No evidence of increased adverse reactions**

Antibiotic therapy

Antibiotics do not have an effect on the immune response to a vaccine. No commonly used antibiotic or antiviral will inactivate a live virus vaccine.

Disease exposure or convalescence

If a child is not severely ill, he or she should be vaccinated. There is no evidence that either disease exposure or convalescence will affect the response to a vaccine or increase the likelihood of an adverse event.

Pregnancy in the household or breast-feeding

All vaccines, including live vaccines (MMR, varicella, and yellow fever) can be given to infants or children with pregnant household contacts, as well as to breast-feeding infants.

Measles and mumps vaccine viruses produce a noncommunicable infection, and are not transmitted to household contacts. Rubella vaccine virus has been shown to be shed in breast milk, but transmission to an infant has rarely been documented (rubella is not transmitted by mouth). Transmission of varicella vaccine virus is uncommon, and most women are immune from prior chickenpox. Oral polio vaccine virus is shed and can spread, but pregnant contacts are at no greater risk than other household contacts in this situation, and OPV has not been shown to cause fetal defects.

Breast-feeding does not decrease the response to routine childhood vaccines, including OPV. Breast-feeding also does not extend or improve passive immunity to vaccine-preventable disease provided by maternal antibody.

Premature birth

Vaccines should be started on schedule based on the child's chronological age. Premature infants have been shown to respond adequately to vaccines used in infancy.

Routine hepatitis B vaccination should not be given until an infant weighs 2 kilograms or more. Infants born to women who are hepatitis B surface antigen positive (from acute or chronic infection) should be vaccinated and given hepatitis B immune globulin regardless of body weight.

Nonspecific allergies, allergies to antibiotics not in vaccine, non-severe egg allergies, and allergies to duck antigens

Infants and children with non-specific allergies, duck or feather allergy, allergy to penicillin, relatives with allergies, and children taking allergy shots can and should be immunized. No vaccine available in the United States contains duck antigen or penicillin.

Non-anaphylactic allergy to vaccine component

Anaphylactic allergy to a vaccine component (such as egg or neomycin) is a true contraindication to vaccination. Non-anaphylactic allergy to a vaccine constituent is **not** a contraindication to that vaccine.

Family history of adverse events unrelated to immunosuppression, or family history of seizures or SIDS

The only family history that is relevant in the decision to vaccinate a child is immunosuppression, and only for oral polio virus vaccine. OPV should not be given to a child with a personal or family history of immunosuppression, because the vaccine virus could spread to the immunosuppressed contact.

Need or requirement for tuberculosis skin test (PPD)

Infants and children who need TB skin tests can and should be immunized. All vaccines, including MMR, can be given on the **same day** as a TB skin test, or **any time after a TB skin test is applied.** For most vaccines, there are no TB skin test timing restrictions at all.

MMR vaccine may decrease the response to a TB skin test, potentially causing a **false negative** response in someone who actually has an infection with tuberculosis. MMR can be given the same day as a TB skin test, but if MMR has been given and one or more days have elapsed, in most situations it is recommended to wait 4-6 weeks before giving a routine TB skin test. No information on the effect of varicella vaccine on a TB skin test is available. Until such information is available, it is prudent to apply rules

for spacing measles vaccine and TB skin testing to varicella vaccine.

Screening for Contraindications and Precautions to Vaccination

The key to preventing serious adverse reactions is screening. **Every person who administers vaccines should screen every patient for contraindications and precautions before giving the vaccine dose**. Effective screening isn't difficult or complicated and can be accomplished with just a few questions.

How is your child (or how are you) today?
This question screens for concurrent moderate or acute illness. If the child has been examined, this question may not be necessary, or may have already been asked.

Does your child have any allergies to any food or medication?
A severe allergy to a vaccine component is a contraindication to vaccination, so this question must always be asked. It may be more time-efficient to inquire about allergies in a generic way (i.e., any food or medication), rather than to inquire about specific vaccine components. Most parents will not be familiar with minor components of vaccine, but they should know if the child has had an allergic reaction to a food or medication severe enough to require medical attention.

Did the child have any problems after his or her last shots?
This open-ended question explores for allergic reactions to previous doses, and for conditions following pertussis vaccine that may be precautions to additional doses, such as high fever or a hypotonic episode.

Does the child have any problems with his or her immune system? This question will help identify children with immunodeficiency who generally should not receive live attenuated vaccines, particularly oral polio vaccine.

Does anyone in your household have a problem with their immune system?
Oral polio vaccine should not be given to a healthy child who has household contact with someone who is immunodeficient.

Screening Questions

- **How is your child today?**
- **Allergies to food or medication?**
- **Any problem after last shots?**

Screening Questions

- **Problems with immune system?**
- **Anyone in household with immune problems?**
- **Blood products in last year?**
- **Pregnant?**

Has the child received any blood products in the last year, like a transfusion, or gamma globulin?
This question helps identify precautions for live attenuated MMR and varicella vaccines, which should not be given to persons who have received passive antibody in the last few months. The question may also expose unreported illnesses that might not have been revealed in earlier questions.

Are you pregnant, or trying to become pregnant?
This question should be asked of **all adolescent and adult women**. MMR and varicella vaccines should not be given to women known to be pregnant or for up to 3 months prior to pregnancy. It is not necessary to inquire about pregnancy in household contacts because a pregnant woman in the household is not a contraindication for administration of any vaccine. ACIP does not recommend pregnancy testing prior to administration of any vaccine.

Every person should be screened for contraindications and precautions prior to vaccination.
Standardized screening forms for both children and adults, developed by the Immunization Action Coalition, are included in Appendix A.

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